CONDENSED MATTER PHYSICS

ELECTRON TRANSPORT THROUGH STRONGLY COUPLED AlInP/GaInP SUPERLATTICES[**]

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For optoelectronic applications, a highly efficient stoichiometrically modifiable alternative to the well-established ternary arsenides, $Al_xGa_{1-x}As$, is desirable. The binary to quaternary phosphides, $(Al_xGa_{1-x})_yIn_{1-y}P$, have the second widest direct band gap of III-V semiconductors—exceeded only by the ternary nitrides, $Ga_xIn_{1-x}N$—with the advantage of GaAs lattice-matching and luminescence in the visible range. Although many redeeming characteristics of the phosphide systems are limited in the arsenide systems, one unfortunate fact remains of the active region regardless of composition—large carrier leakage at room temperature operation. One method of reducing this leakage is to increase carrier recombination by enhancing confinement within the active region. Superlattices have been used to reduce leakage, as in thermalization losses, and enhance carrier confinement in light emitting devices. Incorporating ternary phosphides, specifically $Al_xIn_{1-x}P$ and $Ga_xIn_{1-x}P$, into superlattices has been achieved with success; however, transport through the phosphide superlattices is not as well understood as that of the arsenide superlattices. With a deeper understanding of transport in $(Al_xIn_{1-x}P)_n/(Ga_xIn_{1-x}P)_m$ superlattices, further promising facets of the phosphide-related, optoelectronic avenue will undoubtedly unmask.

Using ballistic-electron-emission spectroscopy (BEES), a three-terminal STM-based technique, electron transport through the principal (Γ-L)-miniband of $(Al_{0.5}In_{0.5}P)_{11}/(Ga_{0.5}In_{0.5}P)_{10}$ superlattice in the strong-coupling regime has been observed at room temperature. Semi-classical (**k**-space) Monte Carlo simulations were performed and were in agreement.

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